USER MANUAL

PXI

SOLID STATE VERY HIGH DENSITY MATRIX MODULE (MODEL No. 40-500)

Issue 2.0 January 2010

ISO 9002
Reg No. FM38792

pickering

www.pickeringtest.com

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SECTION 1 - TECHNICAL SPECIFICATION

40-500
Solid State Very High Density Matrix

- Solid State 1-Pole Matrix
- High Density 64 x 4 Configuration
- 0.5A Hot or Cold Switching
- 1.5A Crosspoint Inrush Current
- ±60 Volt Rating
- Fast Switch Operation and Long Service Life
- VISA, IVI & Kernel Drivers Supplied for Windows 2000/XP/Vista
- Supported by PXI or LXI Chassis
- 2 Year Warranty

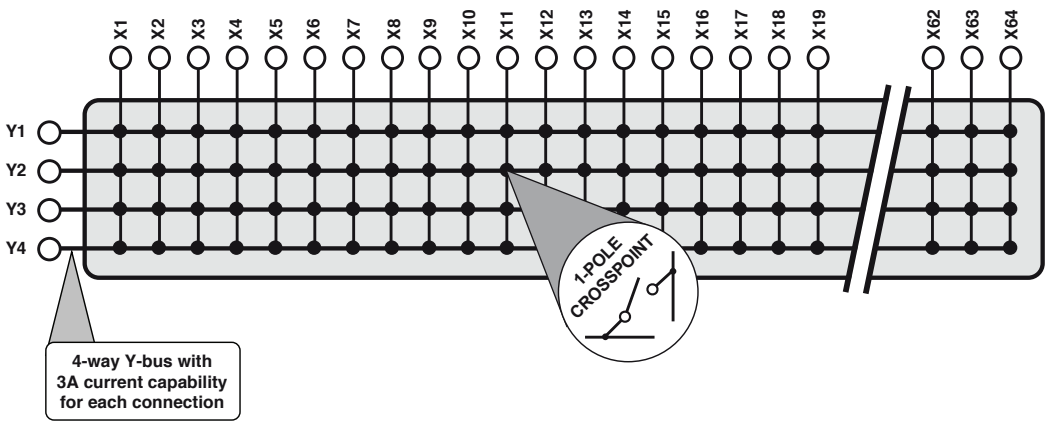
The 40-500 is a very high density matrix using solid state switching configured as a 64x4 1 pole matrix in a single slot 3U PXI module.

It is ideal for applications requiring fast operation and a long service life with frequent switch operations at high currents and voltages. Since the design is based on solid state relays the matrix has no wear out mechanism.

Each matrix crosspoint can switch currents up to 0.5A and can sustain an inrush current of 1.5 A for 100ms, allowing the matrix to be used with capacitive loads. The Y-bus has been designed to carry 3A on each bus, permitting the matrix to be used with multiple crosspoints working at their maximum current at the same time. The module can hot switch voltages up to 60V at full rated current and is suitable for AC or DC operation.

Applications for the 40-500 include routing signals for data acquisition systems or for the slave switching of high current relays. The 40-500 can be used for low current low voltage applications where cost, speed, zero contact bounce and the ability to withstand frequent operation is essential.

Pickering Interfaces is able to offer PXI solid state switching solutions in a variety of configurations. If you have a different requirement for solid state switching contact your local sales office for a quotation.



Switching Diagram for the 40-500 Very High Density Matrix

Switching Characteristics

Switch Type	Solid State Switch
Max Switch Voltage:	±60V (AC peak or DC)
Max Crosspoint Current:	0.5A continuous 1.5A for 100ms
Initial Path Resistance - On: Switch Leakage Capacitance: Leakage Current (off state):	0.9Ω (Y to X) 2.5nF (single Y to X) <4μA at 60V
Turn On Time: Turn Off Time:	<400μs <200μs
Matrix Bandwidth:	2MHz typical (one crosspoint)

Power Requirements

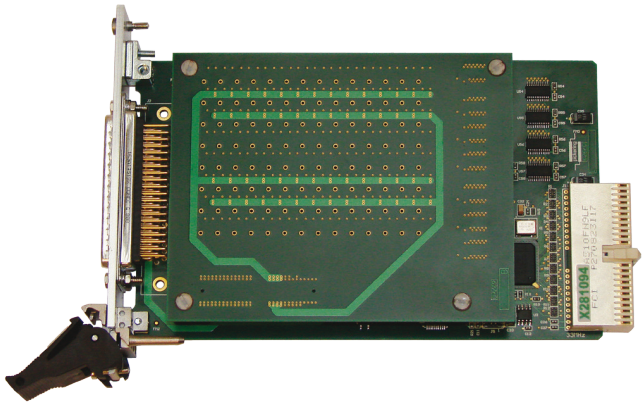
+3.3V	+5V	+12V	-12V
0	0.9 A typical (64 closures)	0	0

Width and Dimensions

Single slot 3U PXI (CompactPCI module).

Connectors

PXI bus via 32 bit P1/J1 backplane connector.
Signals via front panel 78 way D-type male connector, for pin outs please refer to the operating manual.



Side View of the 40-500 Matrix Module

Product Order Codes

Solid State Very High Density Matrix	**40-500-001**

Mating Connectors & Cabling

Examples of connectors and cabling for the 40-500 are:

40-960-078	78 way D Subminiature solder connector
40-970-078-1M	Cableform, 78 way D Subminiature Female to Female, 3A, 1m Length
40-965-078	Connector Block, Shielded, 78 way D Subminiature Module Mounted

Programming

Pickering provide kernel, IVI and VISA drivers which are compatible with Windows 2000/XP/Vista operating systems. The VISA driver is also compatible with Real-Time Operating Systems such as LabVIEW RT. Additionally, QNX is fully supported, for other RTOS support contact Pickering.

These drivers may be used with a variety of programming environments and applications including:

- **National Instruments** products (LabVIEW/LabWindows/CVI/MAX/TestStand etc.)
- **Microsoft Visual Studio** products (Visual Basic/Visual C+)
- **Agilent VEE**
- **Mathworks Matlab**

Drivers for popular Linux distributions are available, other environments are also supported, please contact Pickering with specific enquiries.

Operating/Storage Conditions

Operating Conditions

Operating Temperature:	0°C to +55°C
Humidity:	Up to 90% non-condensing
Altitude:	5000m

Storage and Transport Conditions

Storage Temperature:	-20°C to +75°C
Humidity:	Up to 90% non-condensing
Altitude:	15000m

PXI & CompactPCI Compliance

The module is compliant with the PXI Specification 2.2. Local Bus, Trigger Bus and Star Trigger are not implemented.
Uses 33MHz 32-bit backplane interface.

Safety & CE Compliance

All modules are fully CE compliant and meet applicable EU directives: Low-voltage safety EN61010-1:2001,
EMC Immunity EN61000-6-1:2001, Emissions EN55011:1998.

PXI & LXI Chassis Compatibility

Compatible with all chassis conforming to the 3U PXI and 3U cPCI specification. Compatible with Legacy and Hybrid peripheral slots in a 3U PXI Express chassis.
Compatible with Pickering Interfaces LXI Modular Switching chassis. For information on driving your switching solution in an LXI environment refer to the LXI Short Form Catalog.

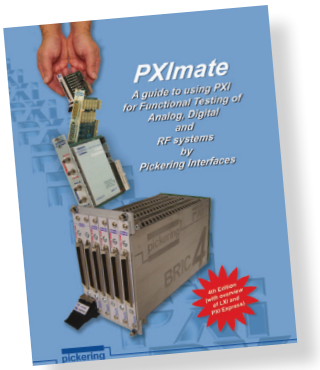
Latest Details

Please refer to our Web Site for Latest Product Details.
www.pickeringtest.com

Please refer to the Pickering Interfaces "**Interconnection Solutions**" catalog for the full list of connector/cabling options, including drawings, photos and specifications. This is available in either print or as a download. Alternatively our web site has dynamically linked connector/cabling options, including pricing, for all Pickering PXI modules.

Refer to the "**PXI Shortform Catalog**" for descriptions of Pickering Interfaces' comprehensive range of PXI switching and instrumentation modules, including specifications and product selection guides

The PXI Shortform is available on request or can be downloaded from the Pickering website.



Ever wondered what PXI is all about?

Pickering Interfaces' "**PXImate**" Explains the basics of PXI and provides useful data for engineers working on switch based test systems.

The PXImate is available free on request from the Pickering website.

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SECTION 2 - TECHNICAL DESCRIPTION

FUNCTIONAL DESCRIPTION

A functional block diagram is provided in Figure 2.1. The Solid State Matrix Module is powered by +5V and +3.3V supplies via Compact PCI connector J1. An additional +2.5V supply is provided by regulator U4. FPGA U1 provides the interface to the Compact PCI bus and is configured by the Flash PROM U3. Output signals from the FPGA control relay drivers U50-58 on the Mother board and U60-66 on the Daughter board via level translation devices U59 and U60. The relay drivers control solid state relays RL1-144 on the Mother board and RL146-257 on the Daughter board which are interconnected to form a 64x4 matrix. User access to the matrix is via the 78-way D-type plug U2 mounted on the module's front panel.

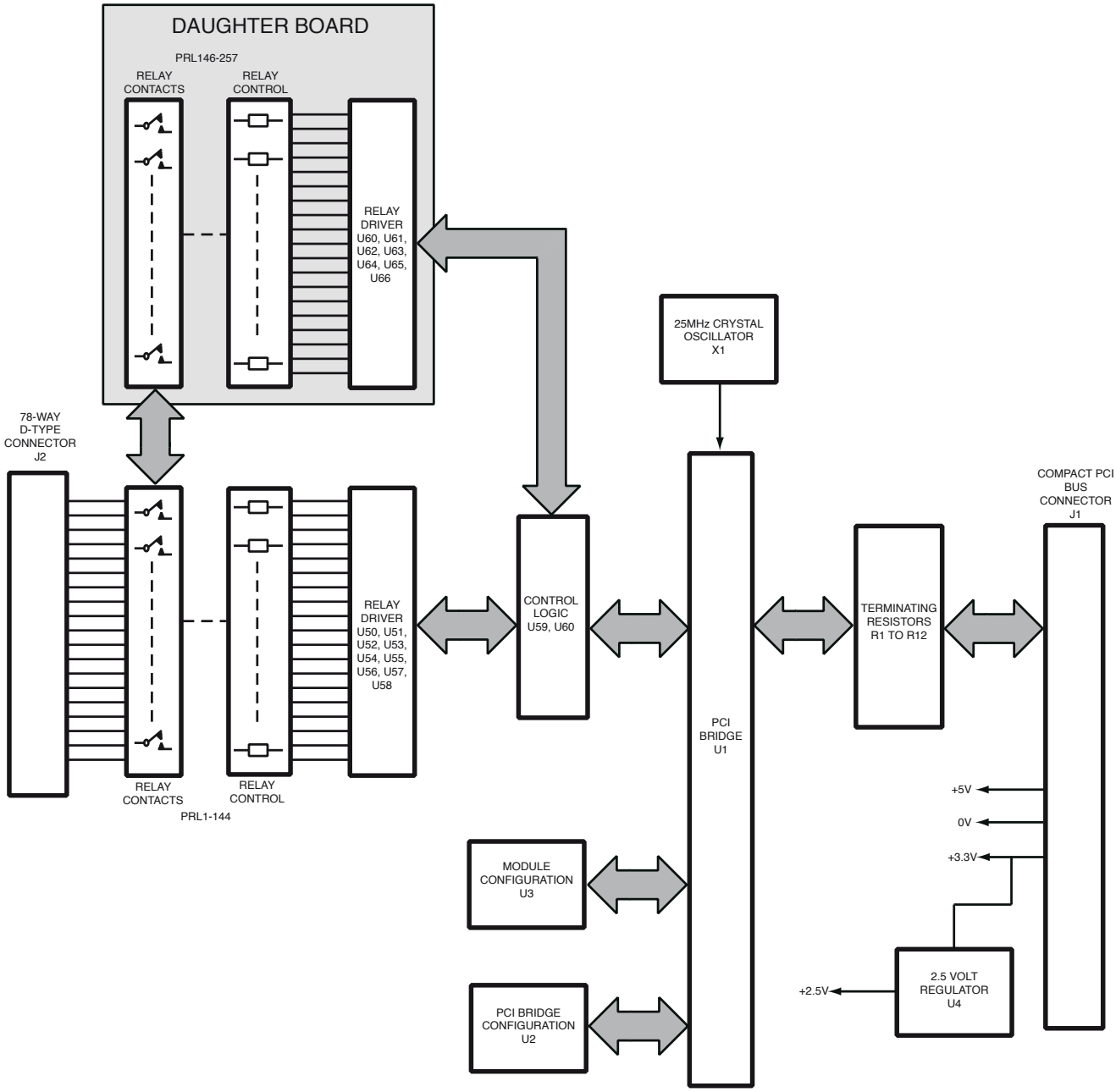

Figure 7.1 - Solid State Matrix Module 40-500: Functional Block Diagram

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SECTION 3 - INSTALLATION

HARDWARE INSTALLATION

CAUTION

Electrostatic discharge can damage the components on the module. To avoid such damage in handling the board, touch the anti-static bag to a metal part of the chassis before removing the board from the bag.

Ensure that there is adequate ventilation in accordance with the PXI Specification.

The module should be installed in accordance with the following procedure:

1. Ensure that the system is turned OFF but still connected to mains so that it remains grounded.
2. Choose an appropriate slot in the rack.
3. Remove the blanking plate for the chosen slot.
4. Ensure that the injector/ejector handle is in its downward position. Align the module with the card guides on the top and bottom of the slot.

WARNING: Do not raise the injector/ejector handle whilst inserting the module. The module will not insert properly unless the handle is in its downward position.

5. Hold the handle whilst slowly sliding the module into the card guides until the handle catches on the injector/ejector rail (refer to Figure 3.1).
6. Raise the injector/ejector handle until the module firmly seats into the backplane. The front panel of the module should be flush with the front panel of the chassis.
7. Screw the front panel of the module to the front panel mounting rail.
8. In a system employing MXI-3 to connect a desktop PC to a PXI chassis or to link multiple chassis, power-up the system as follows:
   - **a.** For a system comprising a PC and one chassis, power up the chassis before powering up the PC.
   - **b.** For a system comprising more than one chassis, turn ON the last chassis in the system followed by the penultimate, etc, and finally turn ON the PC or chassis containing the system controller.
9. For Pickering Interfaces modular LXI installation there is no requirement to use any particular power up sequence.

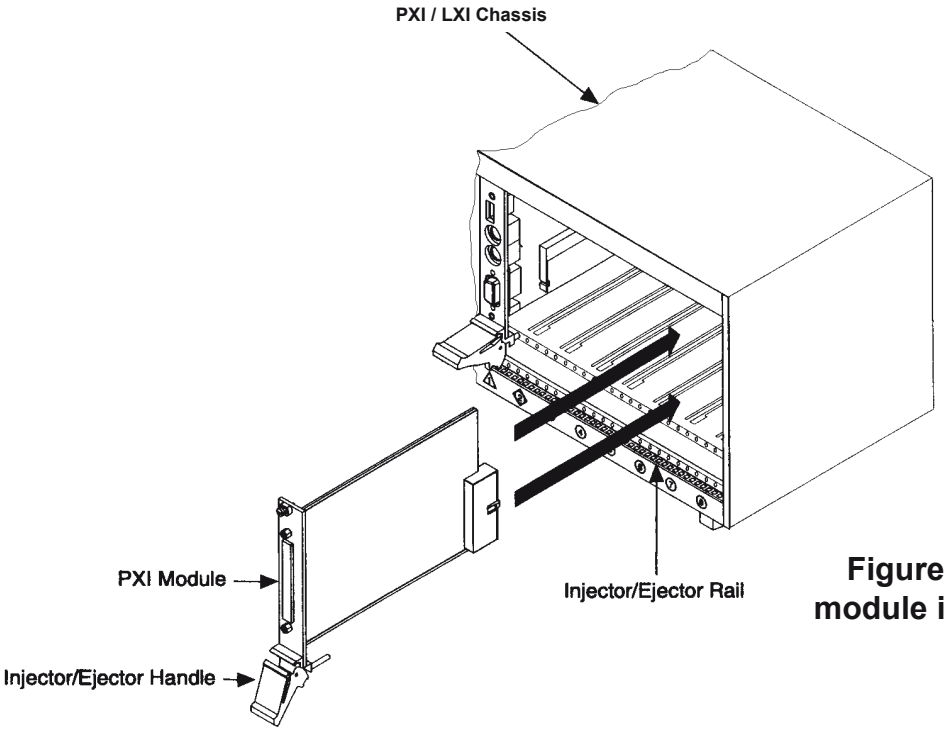


Figure 3.1 - Installing the module into a PXI / cPCI / LXI Chassis

SOFTWARE INSTALLATION

First install the appropriate Pickering PXI switch card drivers by running the installer program Setup.exe, either from the CD-ROM supplied, or by downloading the latest version from our website http://www.pickeringtest.com - the recommended method. There are different versions of the Setup program to suit different Windows versions and software environments. Setup is accompanied by a ReadMe file containing additional installation information. A single installation covers all cards in the System 40, System 45 and System 50 ranges.

When installation completes, the installed drivers' ReadMe file is offered for display. It can also be displayed later using a shortcut on the Programs>>Pickering menu.

If you are not a LabVIEW user you should choose the "full" version, and once that has been installed run the LabVIEW Runtime Engine installer via the shortcut on the Programs>>Pickering menu. In the absence of LabVIEW the Runtime Engine is required to support the Pickering Test Panels application.

SECTION 4 - PROGRAMMING GUIDE

PROGRAMMING OPTIONS FOR PICKERING INTERFACES PXI CARDS

Software drivers are supplied for Microsoft Windows 2000/XP operating systems, with specific support for the following development environments:

- Microsoft Visual Studio (VB, C++, C#)
- Borland C++
- National Instruments LabWindows/CVI
- National Instruments LabVIEW and LabVIEW RT

Windows drivers are supplied in the form of Dynamic Link Libraries, which should also be usable in any other development environment that supports them.

Some recent drivers developed for the LXI platform are capable of addressing both PXI and LXI domains. Such duality may be of help to users considering future migration from PXI based systems to LXI based systems, or indeed systems containing both PXI and LXI components.

Programming for PXI

A number of different Windows drivers are available to meet particular system requirements, and should none of these be suitable there is also the option of register-level programming. Drivers are generally 'universal', handling all models in the System 40, 45 and 50 ranges; however some models that are not compliant with the Ivi Swtch class cannot be used with the pi40iv IVI driver. The pipx40 and Pilpxi drivers are also applicable to certain models in the System 41 (PXI Instruments) range - see these drivers' System 41 support list.

Please note that this documentation is available in its most up-to-date form as HTML help files, fully hyperlinked for easy access - both pipx40 and Pilpxi documents are included in the Pipx40vpp software installation.

IVI Driver for Windows - pi40iv

The pi40iv IVI (Interchangeable Virtual Instrument) driver supports all Pickering Interfaces PXI switch cards that are consistent with the Iviswtch class model - as are the great majority of cards in the System 40/45/50 ranges. It integrates well with LabWindows/CVI and LabVIEW, and is fully compatible with Switch Executive. It is also usable in general-purpose programming environments such as Visual C++ and Visual Basic.

Prior installation of the VISA and IviEngine from National Instruments are required for the correct installation and operation of this driver.

VISA Driver for Windows - pipx40

The pipx40 driver conforms to the VISA (Virtual Instrument Software Architecture) standard for programmable instrumentation. Instrument control environments such as LabVIEW and LabWindows/CVI are based on VISA, and pipx40 support libraries are provided for them.

Prior installation of VISA from National Instruments is required for the operation of this driver.

Where VISA is available, pipx40 can also be used in general-purpose programming environments such as Visual C++ and Visual Basic. When IVI is not a system requirement this driver will often yield faster operation than the pi40iv driver.

Direct I/ODriver for Windows - Pilpxi

The Pilpxi driver accesses cards directly, without using the VISA software layer, while offering similar overall functionality to pipx40. It is most commonly used in general-purpose programming environments such as Visual C++ and Visual Basic. Operating speed of the VISA and Direct I/O drivers is generally comparable.

Register-level Programming

Where the supplied drivers are not suitable, register-level programming can be employed - for example:

- If the functionality of the supplied drivers does not meet the application requirements
- If security considerations demand full source-code for the application
- In development environments that have alternate mechanisms for accessing PCI bus
- For operating systems other than Windows

Programming for LXI

When Pickering PXI cards are inserted into an LXI Modular Chassis a different set of drivers is available.

IVI Driver for Windows - pi40iv

The pi40iv IVI also supports LXI inserted cards simply by changing the resource string to address string to the appropriate address.

Direct I/ODriver for Windows - Piplx

The piplx driver is based on the PXI Direct IO driver pilpxi, but with added functionality to deal with the added need to address the chassis using an IP address. It integrates well with LabWindows/CVI and LabVIEW, and is fully compatible with Switch Executive. It is also usable in general-purpose programming environments such as Visual C++ and Visual Basic.

Please note that this driver may also be used in the PXI domain. If the addressed card is in the local computer PCI/PXI system, commands will be passed through to the PXI Direct IO driver. This mechanism allows the piplx driver to be used for both PXI and LXI cards.

The LXI format offers additional interface options not available in PXI :

.NET

A .NET native driver is also available. Once again this may be used for both LXI and PXI card control.

SOAP

Pickering LXI products include a SOAP interface which is usable from a wide variety of platforms and languages.

SSH

Pickering LXI products include an SSH interface which allows remote command line access to control cards, or, using a suitable package, programmatic control.

The user is advised to visit the Pickering web site for further details of all the above drivers, where documentation, example programs, and further help with driver choice are available.

LabVIEW, LabWindows/CVI and Switch Executive are trademarks of National Instruments Corporation.

General Pickering Card Architecture

With most drivers, before programming a Pickering card it is important to understand the basic architecture of Pickering cards.

The switches on a Pickering card are organized into logical sub-units, each sub-unit containing a set of objects of similar type and use. These objects may be switches, digital outputs, digital inputs, resistors, power supplies etc, depending on the nature of the specific card.

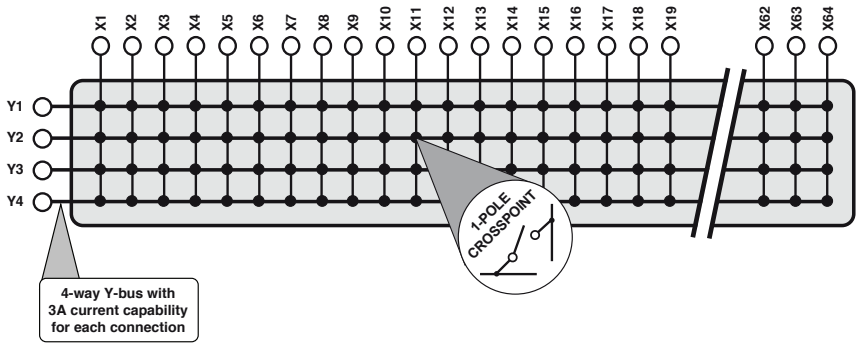
For example a simple matrix card will usually contain a single sub-unit containing the switches arranged in a 2-dimensional array. However a similar card with additional isolating relays connected to the matrix will contain additional sub-units containing those isolation relays.

Low level drivers include functions to allow the programmer to query the card to ascertain the number of sub-units, and the size and type of each sub-unit.

For full details of the driver functions available the programmer should refer to the documentation provided.

MODULE ARCHITECTURE

The 40-500 is a single pole switching matrix with 64 connections on the X-axis and 4 connections on the Y-axis. Connections are made by operating the relays at the crosspoints between X and Y lines allowing single X-Y connections, or X-X connections using a Y line as a path. The matrix architecture is shown in the diagram below:



40-500 64x4 Matrix

The entire matrix is treated as a single programming sub-unit designated as Sub-Unit 1. The following page gives some simple examples using the provided drivers: the IVI driver, the Direct IO driver, and the IVI compliant driver.

PROGRAMMING THE MODULE

Using The IVI Driver, Direct Driver or VISA Driver

This section provides some code fragments which show how to control the High Density Matrix using the IVI Driver, Direct Driver or the VISA Driver.

Once the drivers are installed the manual “Sys40Prg.pdf” and driver help files which fully describes these functions can be found in the Pickering folder(s) or the Pickering entries on your Start Menu.

The card must be opened before use and closed after using the following function calls:

Direct Driver - Open with `PIL_OpenCards` or `PIL_OpenSpecifiedCard` and close with `PIL_CloseCards` or `PIL_CloseSpecifiedCards` respectively.

VISA Driver - Open with `pipx40_init`, and close with, `pipx40_close`.

Setting a Matrix Crosspoint:

Using the IVI driver:

```
pi40iv_Connect(vi, xA1, yA2); //set crosspoint x1, y2 to on
pi40iv_Disonnect(vi, xA1, yA2); //set crosspoint x1, y2 to off
```

Using the Pickering Direct driver:

```
DWORD SubUnit = 1;
PIL_ClearSub(CardNo, SubUnit);    //clear all crosspoints to off state
PIL_OpCrosspoint(CardNo, SubUnit, 1, 2, 1); //set crosspoint x1, y2 to on
PIL_OpCrosspoint(CardNo, SubUnit, 1, 2, 0); //set crosspoint x1, y2 to off
```

Using the VISA driver:

```
ViUInt32 SubUnit = 1;
pipx40_clearSub(vi, SubUnit); //clear all crosspoints off state
pipx40_setCrosspointState (vi, SubUnit, 1, 2, VI_ON); //set crosspoint x1, y2 on
pipx40_setCrosspointState (vi, SubUnit, 1, 2, VI_OFF); //set crosspoint x1, y2 off
```

SECTION 5 - CONNECTOR INFORMATION

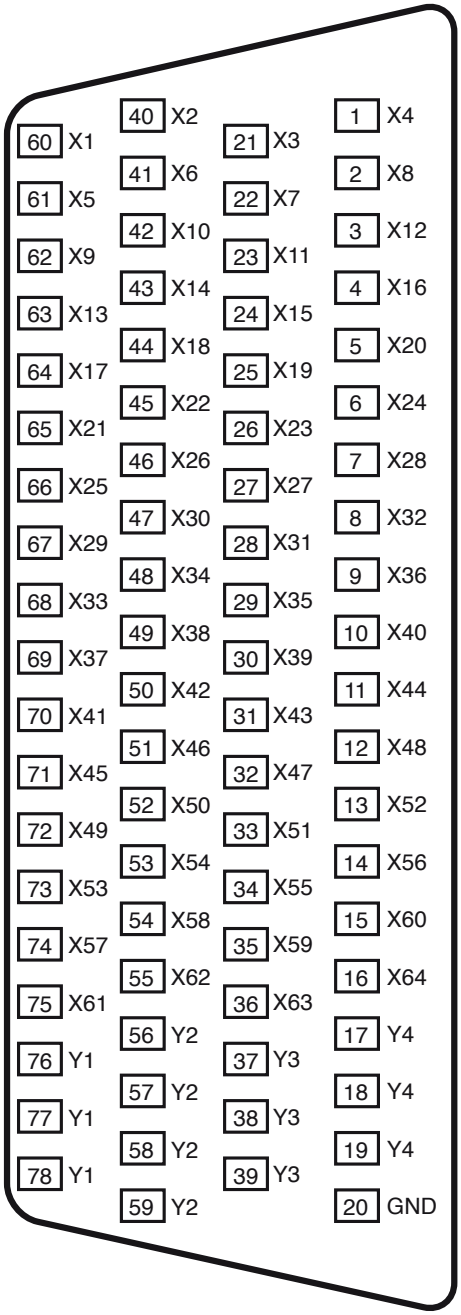


Figure 5.1 - Pin Outs: Solid State Matrix Module 40-500 (78-way D-type Plug)

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SECTION 6 - TROUBLESHOOTING

INSTALLATION PROBLEMS

The Plug & Play functionality of Pickering switch cards generally ensures trouble-free installation.

If you do experience any installation problems you should first ensure that all cards are properly seated in their slots. Improperly mated cards may go undetected by the operating system, or may be detected as a card of an unknown type. They can also cause the computer to freeze at various stages in the boot sequence.

If your system employs MXI-3 you should check the integrity of all MXI-3 links. When the system is powered up, and during Windows start-up, you should expect to see periodic activity on the MXI-3 RX/TX (yellow) indicators, clearing to leave only the PWR/LNK (green) LEDs illuminated. The RX/TX indicators should show activity when you attempt to access a card.

DIAGNOSTIC UTILITY

The Pickering Diagnostic Utility (accessible through the Programs>>Pickering>>PXI Utilities menu) generates a diagnostic report of the system's PCI configuration, highlighting any potential configuration problems. Specific details of all installed Pickering switch cards are included. All the installed Pickering switch cards should be listed in the "Pilpxi information" section - if one or more cards is missing it may be possible to determine the reason by referring to the PCI configuration dump contained in the report, but interpretation of this information is far from straightforward, and the best course is to contact Pickering support: support@pickeringtest.com, if possible including a copy of the diagnostic report.

In the "VISA information" section, if VISA is not installed it's absence will be reported. This does not affect operation using the Direct I/O driver, and is not a problem unless you wish to use VISA. VISA is a component of National Instruments LabWindows/CVI and LabVIEW, or is available as a standalone environment.

If VISA is present and is of a sufficiently recent version, the section "Pipx40 information" should present a listing similar to "Pilpxi information".

Please note that the Diagnostic Utility cannot access cards if they are currently opened by some other application, such as the Test Panels or Terminal Monitor.

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SECTION 7 - MAINTENANCE INFORMATION

SOFTWARE UPDATE

For PXI modules operating in a PXI chassis, no module software updates are required. For the latest version of the driver please refer to our web site www.pickeringtest.com where links to our Software Download page will provide the latest version of the driver software for the various programming environments encountered.

For PXI modules which are supported in one of Pickering Interfaces' Modular LXI Chassis (such as the 60-102 and 60-103) no module software update is required. If the module was introduced after the LXI chassis was manufactured the module may not be recognized, in this case the chassis firmware may need upgrading. This is a simple process which is described in the manual for the Modular LXI Chassis.

RELAY LOOK-UP TABLES

The following pages provide a cross reference between the crosspoints of the Solid State Matrix Module and the physical relays on the mother and daughter PCBs. This table can be used in the fault finding process and should be used in conjunction with the PCB layout diagrams in Figures 7.1 and 7.2 to identify the position of faulty relays. Relays highlighted in blue are located on the motherboard and relays highlighted in yellow are on the daughterboard.

40-500 64x4 MATRIX RELAY CROSS REFERENCE

Cross-point X	Cross-point Y	Relay No.
1	1	RL1
	2	RL2
	3	RL3
	4	RL4
2	1	RL5
	2	RL6
	3	RL7
	4	RL8
3	1	RL9
	2	RL10
	3	RL11
	4	RL12
4	1	RL13
	2	RL14
	3	RL15
	4	RL16
5	1	RL17
	2	RL18
	3	RL19
	4	RL20
6	1	RL21
	2	RL22
	3	RL23
	4	RL24
7	1	RL25
	2	RL26
	3	RL27
	4	RL28
8	1	RL29
	2	RL30
	3	RL31
	4	RL32
9	1	RL33
	2	RL34
	3	RL35
	4	RL36
10	1	RL37
	2	RL38
	3	RL39
	4	RL40
11	1	RL41
	2	RL42
	3	RL43
	4	RL44
12	1	RL45
	2	RL46
	3	RL47
	4	RL48
13	1	RL49
	2	RL50
	3	RL51
	4	RL52
14	1	RL53
	2	RL54
	3	RL55
	4	RL56
15	1	RL57
	2	RL58
	3	RL59
	4	RL60
16	1	RL61
	2	RL62
	3	RL63
	4	RL64
17	1	RL65
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	4	RL68
18	1	RL69
	2	RL70
	3	RL71
	4	RL72
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	2	RL74
	3	RL75
	4	RL76
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	4	RL80
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	4	RL104
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	2	RL106
	3	RL107
	4	RL108
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	2	RL110
	3	RL111
	4	RL112
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	2	RL114
	3	RL115
	4	RL116
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	2	RL118
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	4	RL249
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	4	RL257

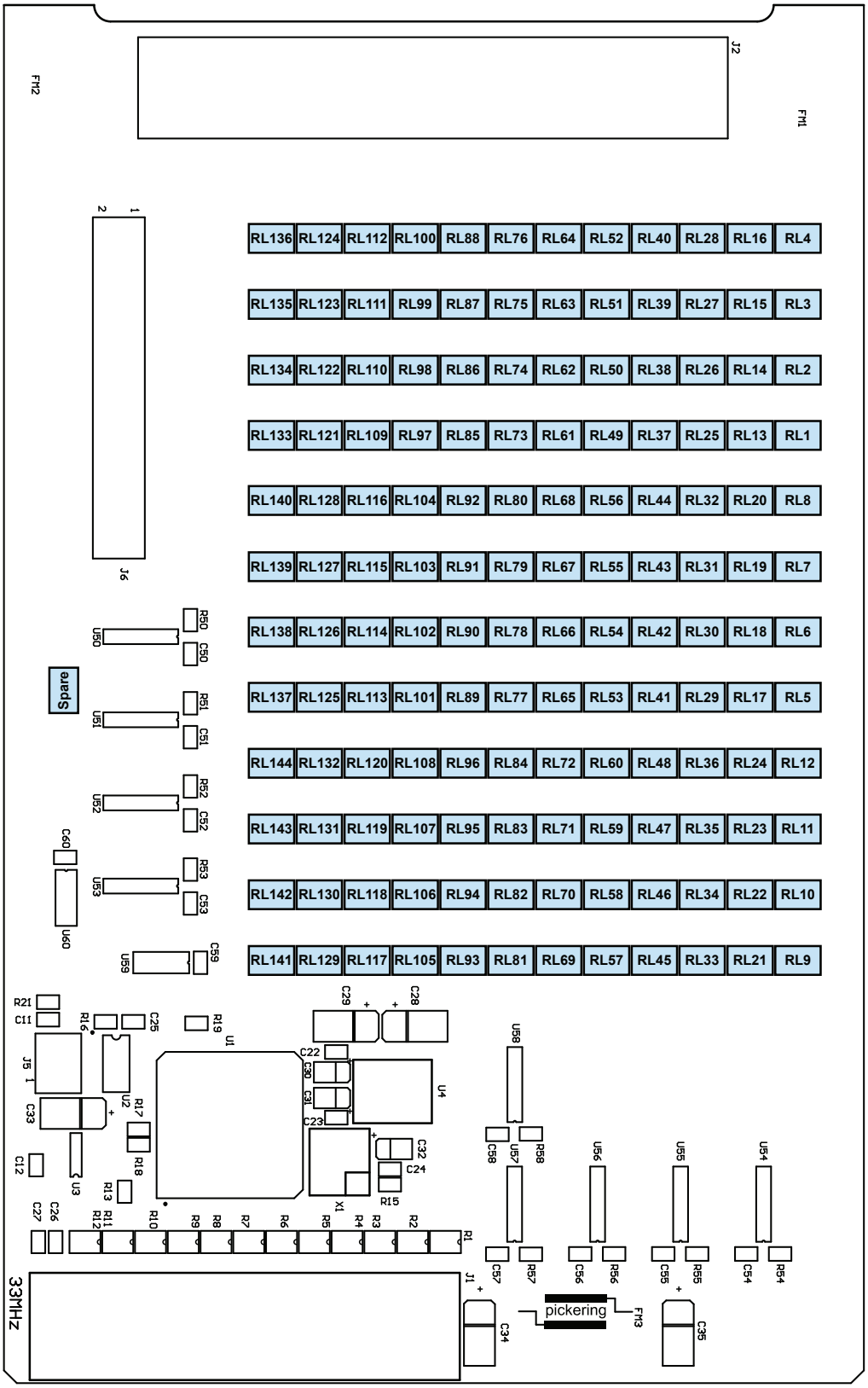


Figure 7.1 - 40-500 Motherboard Component Layout

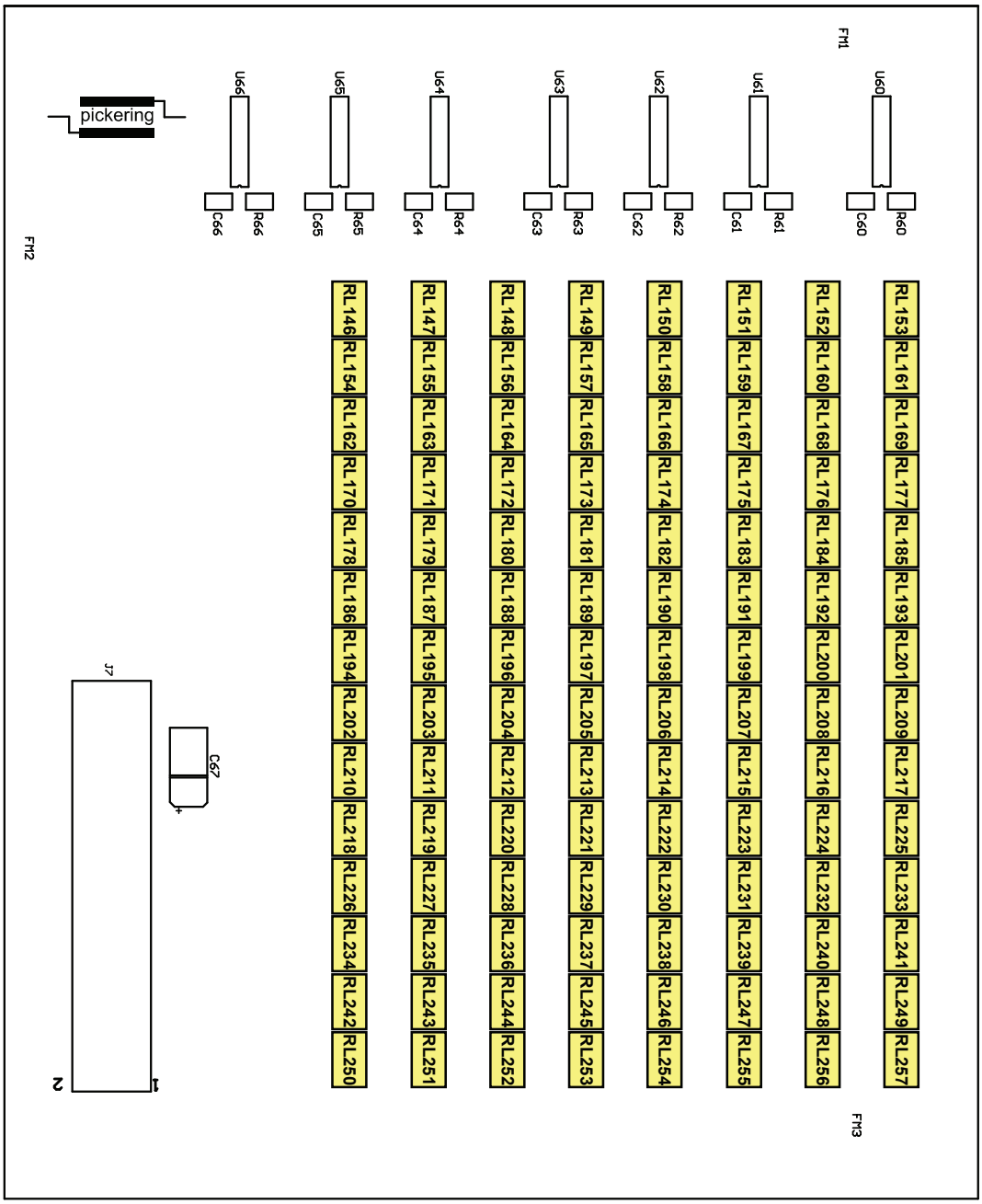
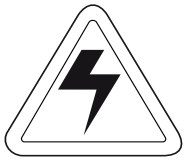


Figure 7.2 - 40-500 Daughterboard Component Layout

SECTION 8 - WARNINGS AND CAUTIONS



WARNING - DANGER OF ELECTRIC SHOCK

THIS MODULE MAY CONTAIN HAZARDOUS VOLTAGES. BEFORE REMOVING THE MODULE FROM THE RACK REMOVE ALL SUPPLIES.

CAUTION
Handling of Electrostatic-Sensitive Semiconductor Devices

Certain semiconductor devices used in the equipment are liable to damage due to static voltage. Observe the following precautions when handling these devices in their unterminated state, or sub-units containing these devices:

(1) Persons removing sub-units from an equipment using these devices must be earthed by a wrist strap and a resistor at the point provided on the equipment.

(2) Soldering irons used during the repair operations must be low voltage types with earthed tips and isolated from the mains voltage by a double insulated transformer.

(3) Outer clothing worn must be unable to generate static charges.

(4) Printed Circuit Boards (PCBs) fitted with these devices must be stored and transported in anti-static bags.

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